CHAPTER 1

Executive Summary

Purpose of this Report

This report presents a Department strategy for the conservation of biological diversity. It provides Department of Natural Resources (DNR) employees with an overview of the issues associated with biodiversity and provides a common point of reference for incorporating the conservation of biodiversity into our management framework. It will be used as a discussion piece for dialogue with the public and will be useful for Natural Resources Board members as they include attention to biodiversity in the development of public policy.

Our goal is sustainable ecosystems. These ecosystems, whether highly modified by humans or largely natural, exhibit ecological characteristics that maintain biological diversity across all land uses. To reach this goal we must develop management solutions that blend people's needs with nature's capacity to sustain those needs over the long term. These management solutions must be founded in the perspective that humans are part of, not apart from, the global ecosystem. Like all species, we depend on a viable biosphere. But unlike other species, we have it in our power to destroy the ecosystems on which we depend. Today's decisions will have far-reaching impacts on the choices and quality of life available to us in the future.

This report provides a historical perspective on natural resources management, reviews the range of public values relating to biodiversity, and explores DNR's role in managing natural resources to conserve biodiversity. It presents ecosystem management as the framework that will help us balance human needs and values with the conservation of biological diversity, and it proposes approaches and tools to help the Department and its partners move more fully into ecosystem management. The report also offers an overview of the state's seven major biological communities, describing each, documenting changes that have occurred since the early 1800s, outlining current issues, and suggesting possible actions.

What is Biodiversity?

Biodiversity is a shortened form of the term "biological diversity." Simply stated, it is the entire spectrum of life forms and the many ecological processes that support them. Biodiversity occurs at four interacting levels: genetic diversity, species diversity, community diversity, and ecosystem diversity. Genetic diversity is the spectrum of genetic material carried by all the individuals of a particular species. Species diversity is the variety of species in a geographic area, including not only the number of species but also their relative abundance and spatial distribution.

A community is an assemblage of different plant and animal species, living together in a particular area, at a particular time, in specific habitats. Communities usually are named for their dominant plant species (for example, pine barrens, sedge meadows, and oak savannas). Communities range in size from less than an acre to thousands of acres. Communities are always changing, though often they change too slowly for humans to notice in our brief lifetimes.

An ecosystem includes not only biological communities but also the myriad, continuing interactions of biological communities with their abiotic (nonliving) environment, including moisture, temperature, sunlight, soil, and many other physical and chemical factors. Ecosystems, which range in size from minute to millions of acres, exhibit complex linkages among plants, animals and the physical and chemical environments. Ecosystem diversity is largely determined by the amount and complexity of these linkages. Ecosystems, like biological communities, are in a constant state of change, called "ecological succession." Succession is the progressive change through time of species composition, organic structure, and energy flows throughout an ecosystem. Human activities and natural phenomena such as fire and tornados can alter succession.

Wisconsin is blessed with abundant biodiversity. Located at the junction of three of North America's six biotic provinces—the eastern deciduous forest, the northern boreal forest, and the temperate grasslands—we have a wealth of species and natural communities. Approximately 1,800 species of native plants and 657 species of native vertebrates have been identified in Wisconsin. In addition, there are thousands of species of nonvascular plants and invertebrates. The challenge is to manage this diversity to conserve Wisconsin's biological heritage and preserve future management options.

Ecological Issues

When the glaciers receded from this part of the continent 10,000-12,000 years ago, humans moved into the area along with colonizing plants and animals. Native Americans managed the landscape using fire, agriculture, and harvest of plants and animals. They undoubtedly affected large portions of the Wisconsin landscape. When European and American settlers moved into Wisconsin in the early 1800s, the state's landscape was characterized by extensive forests, grasslands, wetlands, and a variety of other large communities. Fire, often purposefully set by Native Americans, was a major factor in maintaining many of these communities, especially grasslands, savannas, and barrens. Euro-American settlement brought many changes to this landscape, including suppression of fire, large-scale intensive agriculture, and urban and industrial development. Today, Wisconsin's landscape is a mosaic of urban areas, farms, commercial and recreational forests, lakes and wetlands, and a small amount of land in protected natural areas. All the natural communities present in the early 1800s have been significantly altered in function or size, with some existing today only as remnant areas.

Managing Wisconsin's natural resources in the context of biodiversity requires that we understand the combination of forces that produced today's landscape and the effect of human activities on biological communities and ecosystems. Although these forces are complex, it is important that we understand them, support patterns of resource use consistent with our goal of sustainable ecosystems, and accept responsibility for the problems raised by intensive human use of the landscape. These problems can be grouped into three major categories for discussion: **ecological simplification**, **fragmentation**, and **environmental pollution**.

Ecological simplification means that the interrelationships between organisms and their environments are reduced in number and complexity. Every organism in an ecosystem has one or more roles to play in sustaining that ecosystem. For example, bacteria and fungi cause dead trees to rot, providing nutrients for plants, which in turn provide food for birds and small mammals, which are then eaten by predators. If these natural processes are interrupted, ecological simplification can occur. Simplification is caused by loss of habitat, loss of species in a community, and air and water pollution that affects chemical and physical processes. The addition of non-native species can also simplify biological communities and ecosystems, disrupting the food chain, destroying habitat for native species, displacing native species, and otherwise upsetting natural processes. Ecological simplification can also result from land management practices that reduce natural variety on the landscape, such as filling wetlands or planting only one species of tree. The effects of simplification are often complicated and subtle, reducing the number of species in an area, and the genetic variety among individuals of a species.

Fragmentation is the breaking up of large and continuous ecosystems and communities into smaller areas surrounded by altered or disturbed areas. Modern civilization has greatly fragmented the landscape. Farms have been created in the middle of forests, and prairies have been plowed for agriculture. Wetlands have been filled. Rivers and streams have been dammed, interrupting corridors used for animal movement and isolating populations and habitats. Some species, such as white-tailed deer, do well in these altered landscapes. However, many species of plants and animals have declined in number as habitats have become too small to allow successful reproduction and isolated populations have lost genetic diversity.

Environmental pollution is the human-induced addition of many types of substances to air, land, and water in quantities or at rates that harm organisms, habitats, communities, ecosystems, or human health. Water pollution destroys aquatic habitats and kills aquatic life through toxicity, by destroying habitat, or by using up dissolved oxygen. Acid rain and air-borne contaminants such as heavy metals and pesticides affect both aquatic and terrestrial plants and animals.

Despite the problems caused by ecological simplification and fragmentation, both can be consistent with management objectives. Enhancing populations of certain plant and animal species, providing forest and agricultural products, and accommodating other human activities are obviously important and necessary. The key is to take a landscape-scale view, seeing the overall mosaic of land and water use in Wisconsin; to recognize the impacts of our proposed actions; to clarify where, when, and why these actions are desirable; to know the trade-offs; and to preserve options for future generations.

Wisconsin's Biological Communities

The location and extent of biological communities are determined by environmental factors, including moisture, temperature, soils, and climate. Natural factors, especially the glaciers but also windstorms, fires, droughts, and floods, shaped Wisconsin's landscape. Human activities, beginning with Native American activities and continuing into today's intensive use of land and water, have also had profound impacts on Wisconsin's biological communities.

This report profiles seven major biological communities, which represent an aggregation of the more numerous communities described by scientists (especially Curtis) in the 1950s. These seven communities are northern forests, southern forests, oak savannas, oak and pine barrens, grasslands, wetlands, and aquatic systems.

The term **northern forest** refers primarily to location rather than to any specific species composition. Northern forests contain mixed deciduous and coniferous forests found in a distinct climatic zone that occurs north of a roughly S-shaped transition belt known as the "tension zone" that runs from northwest to southeast Wisconsin. Early forest surveys indicate that northern forests consisted of a mosaic of young, mature, and "old-growth" forests composed of pines, maples, oaks, birch, hemlock, and other hardwood and conifer species. "Old growth" is defined as a community in which the dominant trees are at or near biological maturity.

The late 19th- and early 20th-century loggers cut over virtually the entire northern forest. Conditions remaining after logging were more favorable to hardwood than to pine, resulting in limited pine reproduction after logging ceased. Today, most areas that were formerly in pine are now in oak, maple, and aspen, and the age structure of the northern forest is considerably different than it was before logging occurred. Likewise, distribution and abundance of animals in the northern forests have been altered dramatically, with some species declining in numbers and others, finding the current forest advantageous, increasing their populations.

The major biological issue relating to the northern forests is that they have been managed on a stand-by-stand basis with little regard for sustaining landscape or regional diversity. The major forest cover types are managed largely for harvest at an economically desirable rotation age, which perpetuates the limited age structure of northern forest communities. Fortunately, there is great potential for maintaining and even enhancing biological diversity in the northern forests. We have lost very few plant or animal species from the area. The key is to use a landscape approach that can produce all the successional stages, from young trees to old growth, within large and small stands in the forest mosaic.

Early European observers recognized **southern forests** (those south of the tension zone) as distinct from the northern types because of the predominance of oaks and general absence of conifers. They also noted the relative openness or park-like appearance, created by the lack of small trees and shrubs. There is evidence that these southern forests were shaped by fire in the previous 5,000-6,000 years. Beginning in the early 1800s, the southern forests were cleared for farming or harvested for lumber, fuel, and railroad ties. Fire was also suppressed. As a result, the southern forests are today severely fragmented into small woodlots. Remaining forest cover is heaviest in the southwest coulee region. The large herbivores and carnivores originally found in the southern forest, including buffalo, elk, and cougar, are gone. These species and others were unable to survive on increasingly smaller patches of appropriate habitat and were also affected by land development practices and over-harvest by settlers. Some bird species (notably the passenger pigeon) have also been lost, though many remain in reduced numbers.

Forestry practices that reduce fragmentation, increase the use of fire, and manage the old-growth forests that remain on public lands are key to restoring biological diversity on southern forests.

Oak savannas are characterized by open grassland areas interspersed with trees, especially oaks. Savannas, historically found in southern and western Wisconsin, were the gradation between the great prairies and the eastern deciduous forests. The savannas were perpetuated by fire. In the early 1800s, Wisconsin had perhaps 5.5 million acres of oak savanna, virtually all of which has been destroyed for farming and urban development or has succumbed to natural succession as fire has been suppressed. Oak savanna is now virtually nonexistent in Wisconsin, with only a few remnant areas remaining.

Many animal species associated with savannas have managed to find surrogate habitats such as wooded pastures, lawns, and small woodlots. Savanna vegetation has not fared as well. Many savanna plant species are now uncommon and found only on the fringes of oak woods, brushy areas, and lightly grazed pastures. Fortunately, oak savanna restoration is possible, through the use of fire and perhaps light grazing.

Oak and pine barrens, like savannas, depend on fire to maintain their unique character. These communities, which are found in central and northern Wisconsin where soils are poor, are characterized by sparse scrub pine or oak scattered among shrubs, brush, and grasses. In the early 1800s, barrens covered about 4.1 million acres of Wisconsin. Barrens communities have been destroyed by agriculture and urban development, or have succeeded to forests in the absence of fire. Only a few remnant areas remain. As with other communities, many of the plant and animal species associated with barrens have managed to survive, though often in reduced numbers. The potential for restoration of barrens areas on public and private lands is good if controlled burning and cutting are used as management tools.

Wisconsin's **grassland** (prairie) communities, characterized by the absence of trees and large shrubs and the dominance of grass and forb species, are at the periphery of the extensive North American mid-continent grassland biome, which lies south and west of the state. These grass-

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lands, which grew up 5,000-6,000 years ago after the glaciers retreated, were maintained by fire and probably by large grazing animals such as buffalo. Prior to Euro-American settlement, Wisconsin had about 3.1 million acres of prairies, of which almost one million acres were a wet prairie type known as "sedge meadow."

The grassland biome has been degraded throughout its range, generally from farming and grazing, but also from urban development. Some prairie areas also grew up into trees and shrubs as fire was controlled. Thus, the prairie community has been severely fragmented, with only a few remnant areas left. Prairies, along with oak savannas, are the most endangered natural communities in Wisconsin. As a result, an estimated 15%-20% of the state's original grassland flora is now considered rare here. Grassland mammals and birds adapted better, using "surrogate" grasslands such as pastures for their survival needs. Managed use of fire, removal of trees and shrubs, light grazing, and perhaps some crop production will aid prairie restoration. Populations of grassland mammals and birds can also be restored by establishing "surrogate" grassland habitat on both private and public lands.

Wetlands, which are lands on which soils or substrate is periodically saturated with or covered by water, occupied an estimated ten million acres (nearly one-third of Wisconsin's land area) in the early 1800s. Wetlands have been subject to intense modification, mainly through draining and filling for agriculture and urban development. Today, about 5.3 million acres of wetlands remain. Nearly all the remaining wetlands have suffered from the effects of fragmentation and simplification.

Current federal, state, and local regulations and land acquisition programs have considerably slowed wetland loss. However, nonagricultural filling of wetlands, especially along lake shores, continues to threaten some wetlands. In addition, the invasion of exotics such as purple loosestrife pose a threat to wetland ecology. Some wetland communities are easily restored by simply blocking drainage and allowing water levels to rise; others require decades or longer to restore natural functions.

When the glaciers receded, they left behind a variety of **aquatic communities**, including springs, ponds, lakes, streams, and rivers. Within this grouping is a wide variety of systems, differing in size, fertility (lakes), water temperature (streams), and geographic area. Wisconsin has 620 miles of Great Lakes shoreline, more than 14,000 lakes covering a total of a million acres, and more than 33,000 miles of rivers and streams, including 1,500 impoundments.

Simplification of many aquatic systems has occurred due to introduction of exotic species of fish such as carp and lamprey, which successfully compete against many native species, as well as to the large-scale destruction of shorelines and other habitats. Fragmentation has been caused by dam construction. Dams block movement of fish and other aquatic organisms, isolating populations, and sometimes resulting in loss of genetic diversity and eventual extirpation of species in a portion of the river. Dam construction also changes water flow and temperatures, resulting in changes in habitat that can lead to extirpation of species. Other activities that create pollution or cause simplification and fragmentation of aquatic systems include agricultural and urban development and resulting runoff, channelization of streams, shoreline development and resulting loss of habitat and spawning areas, and industrial and urban development and resulting effluent and runoff. In addition, some fisheries management activities such as indiscriminate stocking have also contributed to disturbance of aquatic communities.

Although the abundance of many fish species has been greatly altered, most native fish species are still abundant and self-sustaining. This relative health of aquatic communities allows us to focus attention on identifying and restoring specific degraded communities as well as protecting species with declining numbers. River and stream communities respond quickly to habitat protection and restoration. Lake communities respond more slowly. It is important to shift aquatic community management from a single-species focus to an ecosystem-management focus.

What This Report Proposes

DNR's mission is to conserve, protect, and manage both individual species and natural systems. We have a proud tradition of leadership in adapting management techniques based on the cutting edge of knowledge of natural systems. The rapid growth of new knowledge about ecosystems demands that we change the way we view and resolve management problems. Many Department employees are, and have been, using ecological principles in formulating their management actions. We need to build on our existing base of knowledge and experience.

This report, which attempts to bring together current knowledge of biodiversity and to stimulate thinking on the issue, is a step in this direction. It contains two types of recommendations. The first are broad **strategic recommendations**. These are described generally below and in more detail at the end of the next chapter. We recommend that the Department:

- Apply ecosystem management principles and practices to the Department's programs so that goals and priorities for biodiversity can be determined in the context of ecological, socio-economic, and institutional issues.

- Build partnerships with other agencies, local governments, tribes, the business community, scientists, and interest groups to accomplish common goals for ecosystem management, including specific attention to biological diversity.

- Build partnerships with private landowners to accomplish common goals for ecosystem management, recognizing that the Department cannot accomplish the breadth of what needs to be done to conserve biodiversity by working on public lands alone.

- Develop innovative and proactive information and education strategies for Department staff and the public regarding biodiversity and its relation to ecosystem management.

The second type of recommendations are **possible actions specific to each of the seven biological community types** described and assessed in this report. These are listed at the end of each of the seven biological community chapters that comprise the bulk of this report. We call these "possible actions" because they are consistent with ecosystem management but require more analysis and planning. How priorities are set within this list will be based on ecoregion goals, staff workload, fiscal resources, public input and support, and legal authority. We will work with our customers and clients to set priorities and bring recommendations to the Natural Resources Board for consideration beginning in the 1995-97 biennium.

> This report proposes that the best way to address biodiversity as a management issue is to apply the principles of ecosystem management to Department planning and programs. Ecosystem management is a system to assess, conserve, protect, and restore the composition, structure, and function of ecosystems, to ensure their sustainability across a range of temporal and spatial scales, and to provide desired ecological conditions, economic products, and social benefits.

A strategy for applying ecosystem management requires at least three important building blocks:

- Use the ecosystem management decision model, as described in this report, to think through alternatives and make decisions. It is a model that requires us to propose and evaluate alternative actions from their ecological, socio-economic, and institutional (laws, rules, policies) perspectives. This approach will help us frame issues in the context of their ecological, social, and economic consequences. In doing so, we will be in a better position to make decisions that include human needs and values while preserving a wide range of options for future generations.

- Use ecoregions as the geographic basis for developing consensus on regional goals for program planning. Ecoregions are large areas of the state that exhibit similar patterns in potential natural communities, soils, hydrologic conditions, landforms, lithology, climate, natural processes, and resource or land-use patterns. The ecoregion approach will enable us to set clear and measurable goals for protecting and managing biological communities.

- Use logical steps to conserve biodiversity and retain future options, using the best information we have now, while continuously evaluating and improving our approach as more information becomes available. We must make and improve decisions in the face of uncertainty. Scientists have developed a method, known as "adaptive management," to do this. Adaptive management is a formal, structured approach to dealing with uncertainty in natural resource management, using the experience of management as an ongoing, continually improving process. This process will help us implement ecosystem management at a landscape scale, using a strong science base and a clear record of why we are using particular management practices.

Some Continuing Policy Questions

Although we have identified key strategic and policy recommendations that we are ready to implement with our partners and customers, we are aware that this report will continue to raise important policy questions over time. These questions affect the balance of interests among a wide range of organizations and people. We have not identified all the implications, but we list a number of them below. They relate to issues of organization, budget, customers, skills, and management.

- ▲ How will including biodiversity as a criterion affect the balancing of multiple views in DNR decision-making?
- ▲ How do our traditional customers perceive their interests being represented within ecosystem management and attention to biodiversity?
- ▲ Are the present DNR budget structure and associated constraints flexible enough to deal with ecosystem management and biodiversity issues?
- ▲ Should we hire employees with differing skills than those we now hire if we broaden our concern for biodiversity?
- ▲ What will be the role of surrogate biological communities (e.g., switch-grass-dominated grasslands instead of multi-species prairies) or surrogate processes (e.g., clearcutting instead of burning a forest stand) in meeting our objectives for biological diversity?
- ▲ To what extent should early 19th-century native plant communities be restored? At what cost? What is biologically possible and what can be economically justified?
- ▲ How should the Department's environmental quality programs integrate ecosystem management and biodiversity concepts into their planning and permitting processes?